

REMARKS

The Examiner is thanked for the thorough examination of the application. No new matter is believed to be added to the application by this Amendment.

Status Of The Claims

Claims 7-12 and 22-30 are pending in the application. Claims 7-12 have been withdrawn from consideration. Claims 1-6 and 13-21 have been canceled by this amendment. Claim 22 corresponds to canceled claim 1 and finds further support in the preferred embodiments set forth in the specification. Claim 23 finds support in the specification at page 6, lines 5-8. Claim 24 finds support in the specification at page 4, lines 21-25. Claim 25 finds support in the specification at page 13, lines 17-20. Claim 25 finds support in the specification at page 12, lines 21-24. Claim 26 finds support in the specification at page 4, lines 21-25 and at page 12, lines 21-24. Claims 28, 29 and 30 correspond to canceled claims 2, 3 and 4, respectively.

Claim Rejections – 35 USC § 103(a)

Claims 1-3, 5, 6, 13, 15 and 21 have been rejected under 35 USC § 103(a) as being unpatentable over Qiu '849 (U.S. Patent 6,419,849) in view of Qui '353 (WO99/36353, using U.S. Patent 6,455,106, which claims priority of Qui '353).

Claim 4 has been rejected under the provisions of 35 USC § 103(a) as being rendered unpatentable over Qiu '849 in view of Qui '353 and further in view of Lee '092 (U.S. Patent 5,763,092).

Claim 14 has been rejected under the provisions of 35 USC § 103(a) as being rendered unpatentable over Qiu '849 in view of Qui '353 and further in view of Yonezawa et al. US '630 (U.S. Patent 3,963,630).

Claims 16 and 18 have been rejected under the provisions of 35 USC § 103(a) as being rendered unpatentable over Qiu '849 in view of Qui '353 and further in view of Ishizawa et al. (*Jpn. J. Appl. Phys.*, 29, pp. 2467-2472).

Claim 17 has been rejected under the provisions of 35 USC § 103(a) as being rendered unpatentable over Qiu '849 in view of Qui '353 and further in view of Borodin et al. '744 (U.S. Patent 5,069,744).

Claims 18-19 have been rejected under the provisions of 35 USC § 103(a) as being rendered unpatentable over Qiu '849 in view of Qui '353 and further in view of Naito et al. '368 (U.S. Patent 5,790,368).

Claim 20 has been rejected under the provisions of 35 USC § 103(a) as being rendered unpatentable over Qiu '849 in view of Qui '353 and Ishizawa et al., further in view of Yonezawa et al. '630.

Applicants traverse. Reconsideration and withdrawal of each of the above rejections is respectfully requested based on the following considerations.

Distinctions of the invention over Qiu '849 and the secondary references (excepting Qui '353, which is newly applied) have been placed before the Examiner. For brevity, the traversals of record are not repeated here.

The present invention, such as is set forth in independent claim 22, pertains to a method for preparing a thin film of a metal oxide having perovskite crystal structure and expressed with

chemical formula ABO_3 . A dried gel film is prepared with a sol-gel process, and the metal oxide is prepared by subjecting the dried gel film in an alkaline aqueous solution. The aqueous solution includes every metallic element or elements of A in ABO_3 , and a metallic element or elements present in the aqueous solution are only the every metallic element or elements of A in ABO_3 . For example, when $BaTiO_3$ is prepared, the aqueous solution includes only barium as a metallic element. When elements expressed by A are Ba and Pb, the alkaline solution includes both Ba and Pb, and the alkaline solution does not include only a part of them, for example, only barium.

Qiu '849 pertains to a precursor of a piezoelectric material that is prepared with a sol-gel process, and the precursor is subjected to hydrothermal treatment. The piezoelectric material has perovskite crystal structure expressed with chemical formula ABO_3 . In the examples of in Qui, only Ba and Pb are used for the divalent metallic element at site A. Pb has an important role on piezoelectricity, while Ba contributes to the alkaline environment for the hydrothermal treatment.

The method of Qiu '849 positively uses an undesirable characteristic, that the metallic element "a" at site A in the precursor can be replaced easily with metallic element "a' " in the solution for hydrothermal treatment. For example, a precursor of an oxide including element "a' " (such as Pb) is prepared with a sol-gel process. Next, the oxide is subjected to hydrothermal treatment with an aqueous solution including an element "a' " different from the element "a" so as to replace "a' " with "a". The resultant piezoelectric material includes both "a" and "a' " as element "A".

For example, in the first manufacturing method of Qiu '849, a precursor metal oxide including Pb, Ti, and Zr is subjected to hydrothermal treatment using a $Ba(OH)_2$ aqueous solution. Next, a $Pb(OH)_2$ solution is used for hydrothermal treatment. In the third

manufacturing method of Qiu '849, the precursor metal oxide is subjected to hydrothermal treatment with use of a mixed aqueous solution of $\text{Ba}(\text{OH})_2$ and $\text{Pb}(\text{OH})_2$. In the second manufacturing method, a precursor metal oxide including $\text{Ba}(\text{Ti,Zr})\text{O}_3$ is subjected to hydrothermal treatment with use of a $\text{Pb}(\text{OH})_2$ aqueous solution. Thus, a part of "a"=Ba is replaced with "a' " =Pb to create $(\text{Ba,Pb})(\text{Ti,Zr})\text{O}_3$.

That is, the method of Qiu '849 may appear similar to the invention in that both sol-gel process and hydrothermal treatment are used. However, there are fundamental differences between the present invention and Qiu '849

In the invention, the alkaline solution includes only the element or elements represented as A in ABO_3 as the metallic element or metallic elements. For example, in the production of BaTiO_3 , a dried gel film includes Ba, and it is subjected to hydrothermal treatment in a $\text{Ba}(\text{OH})_2$ aqueous solution. The $\text{Ba}(\text{OH})_2$ aqueous solution is an alkaline solution including Ba represented as "A" in ABO_3 as the only metallic element present in the solution.

On the other hand, the aqueous solutions for the hydrothermal treatment used by Qiu '849 includes element "a" to be replaced with element "a' " included in the precursor, and do not include element "a' ". The element "a" is different from the element "a'" because Qiu '849 uses the above-mentioned chemical process, which is not used in the invention. In an example of Qiu '849, a sol-gel film including Ti and Pb ("a' ") is subjected to hydrothermal treatment in $\text{Ba}(\text{OH})_2$ aqueous solution ("a" = Ba). It is to be noted that if "a"= "a' " =Pb, a PbTiO_3 film cannot be crystallized (Qiu '849 at col. 2, lines 54-57). Then, instead of producing PbTiO_3 directly, Qiu '849 uses the above-mentioned atomic exchange in the hydrothermal treatment. For example, a $\text{Ba}(\text{OH})_2$ aqueous solution including Ba different from Pb is used for

hydrothermal treatment, in order to use the atomic exchange between Pb and Ba. Then, an additional hydrothermal treatment with a $\text{Pb}(\text{OH})_2$ aqueous solution is used to exchange Ba with Pb again in order to enhance Pb concentration or to decrease Ba concentration. In the additional hydrothermal treatment, the $\text{Pb}(\text{OH})_2$ alkaline solution does not include all the metallic elements Pb and Ba as A in ABO_3 .

In contrast the present invention, for example, has a $(\text{Ba,Sr})\text{TiO}_3$ sol-gel film (“a”=Ba and Sr) being subjected to hydrothermal treatment in a mixed solution of $\text{Ba}(\text{OH})_2$ and $\text{Sr}(\text{OH})_2$ (“a”=Ba and Sr=“a”). The exchange between Ba and Sr is not used. Thus, the chemical process of the present invention is fundamentally different from Qiu ‘849.

Also, Lee ‘092 describes producing a material covered with a hydroxy apatite ($\text{Ca}_3(\text{PO}_4)_2$ - $\text{Ca}(\text{OH})_2$) film. That is, Lee ‘092 is not relevant to a metal oxide having a perovskite structure. In the hydrothermal treatment, water or an aqueous solution including hydroxy apatite particles is used. However, Lee ‘092 fails to suggest “an alkaline solution including only the one or more metallic elements in the metal oxide as a metallic element or elements present in the solution”.

As a result, one of ordinary skill in the art would not be motivated by Qiu ‘849, in any combination with the secondary references, to produce claim 22 of the present invention. A *prima facie* case of obviousness has thus not been made. Claims depending upon claim 22 are patentable for at least the above reasons.

These rejections are overcome and withdrawal thereof is respectfully requested.

Information Disclosure Statement

The Examiner is thanked for considering the Information Disclosure Statement filed September 22, 2003 and for making the initialed PTO-1449 form of record in the application in the Office Action mailed June 7, 2005.

The Drawings

The Examiner has accepted the drawings in the Office Action mailed June 7, 2005.

Conclusion

In view of the above amendment, applicant believes the pending application is in condition for allowance. It is believed that a complete and full response has been made to the Office Action, and no issues remain. The Examiner is accordingly respectfully requested to issue a Notice of Allowability.

Should there be any outstanding matters that need to be resolved in the present application, the Examiner is respectfully requested to contact Robert Goozner, Reg. No. 42,593 at the telephone number of the undersigned below, to conduct an interview in an effort to expedite prosecution in connection with the present application.

Application No. 10/665,496
Amendment dated August 22, 2006
Reply to Office Action of May 22, 2006

Docket No.: 0020-5179P

If necessary, the Commissioner is hereby authorized in this, concurrent, and future replies to charge payment or credit any overpayment to Deposit Account No. 02-2448 for any additional fees required under 37.C.F.R. §§1.16 or 1.14; particularly, extension of time fees.

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Respectfully submitted,

REG

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